REMARKS

Claims 1-5 are pending in the subject application. Claim 1 has been amended herein. Support for the amendment to claim 1 is found throughout the Specification and claims, as filed, and no new matter is presented by the amendment.

Favorable reconsideration in light of the remarks which follow is respectfully requested.

1. 35 U.S.C. §112 Rejections

Claims 1-5 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite. The Office states that:

> In claim 1, line 10, the limitation "space wavelength of the dielectric" is vague as the dielectric does not have a wavelength; however, the microwave has wavelength wherein its value is affected by the medium through which it travels. For the sake if examination, the Examiner has interpreted the above limitation as the wavelength of the microwave in the dielectric window in contact with the slot antenna plate.
>
> Further, the specification on page 9, lines 1-25, corresponding to page 7 of the applicants remarks, is also vague in defining the correlation between the wavelength of the length of the slot. For example, according to line 7 of the specification, "the longer side of the rectangular slot of the slot antenna is $2/\lambda$" rather than $\lambda/2$, that is, half of the microwave wavelength in the dielectric window. It is further not clear whether the value of 20 mm, recited on page 9, line 2 of the specification, is referring to the wavelength of the microwave in the dielectric window or the length of the slot.

Regarding the limitation "space wavelength of the dielectric", Applicants have amended the claims and specification as recommended. Reconsideration and withdrawal of the rejection is respectfully requested.

Regarding the specification, wherein it is set out that the longer side of the rectangular slot of the slot antenna is $2/\lambda$ rather than $\lambda/2$, Applicants have amended this typographical error. Reconsideration and withdrawal of the rejection is respectfully requested.

Regarding the specification on page 9, line 2, where a value of 20 mm is set out, Applicants respectfully submit that on page 9, lines 1-5 of the specification, it is set out that:

> Slot 7a is a rectangular for example. Then, slot 7a is designed to have the longer side with a half length of the space wavelength in the dielectric (e.g. approximately 20 mm provided that that dielectric has a relative dielectric constant of 10 and the frequency is 2.45 GHz) and to have the shorter side which is one-half or less of the longer side in length.

Thus, "a half length of the space wavelength in the dielectric" is "approximately 20 mm" and "the longer side of the rectangular slot" equals to "a half length of the space wavelength in the dielectric." As such, "the longer side of the rectangular slot" is also "approximately 20 mm." Therefore, the dimension "20 mm" refers to both the length of the opening and the wavelength.

2. 35 U.S.C. §103 Rejections

Mabuchi et al in view of Yoshiki et al

Claims 1, 2, 4 and 5 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Mabuchi et al (US Patent No. 5,645,644) in view of Yoshiki et al (US Patent No. 5,843,236). The Office acknowledges that "Mabuchi et al fail to explicitly disclose the length of the slit opening in terms of the wavelength of the microwave." However, the Office asserts that:

> Yoshiki et al teach a microwave plasma processing system wherein the length of the slits are defined in term of wavelength of the microwave passing therethrough to be n/2 of a free-space wavelength of the microwaves in order to uniformly transmit microwaves into a process space (column 10, lines 12-26, column 19, lines 63-67, column 32, lines 8-11).
>
> Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the slit dimension according to that taught by Yoshiki et al in order to generate plasma more efficiently and uniformly.

Applicants respectfully traverse. Applicants claim, in claim 1, a plasma processing apparatus comprising: a process chamber for processing by means of plasma; microwave transmission means for transmitting microwave to said process chamber; a dielectric for radiating the microwave transmitted by said microwave

transmission means into said process chamber; and a slot antenna plate formed of conductor, placed on a side, facing said process chamber, of said dielectric, and including an opening for passing the microwave therethrough radiated from said dielectric wherein said opening of said slot antenna has a longer side with its length equal to half the space wavelength of the microwave.

Mabuchi describes a plasma processing apparatus wherein a microwave window is supported by a beam structure. The beam structure is formed so as to reinforce the microwave window against the differential pressure between the interior and exterior of the reaction chamber. According to Mabuchi, the

> Beams are made of a metallic material such as stainless steel as a base material for providing a sufficient strength, and therefore no plasma is generated beneath the beams. * * * Accordingly, in order to render the uniform plasma processing to the sample, it must be spaced out from the beams by a distance enough for plasma to spread by diffusion. (Col. 2, line 66- col. 3, line 7)

Thus, according to Mabuchi, distribution of uniform plasma to the sample is accomplished by proper placement of the sample with relation to the beam structure. Uniformity of the plasma is further accomplished by supplying the inherently inactive gas to the reaction chamber. As a result,

> [T]he quantity of plasma generation in the neighborhood of the beams is increased by the high-density gas. Consequently, plasma spreads uniformly at positions with short distances from the beams owing to the enhancement of plasma generation beneath the beams. In addition, a sufficient supply of gas from the beams to the central portion of the reaction chamber creates a uniform gas distribution even in the case of a larger reaction chamber. (Col. 3, lines 19-32)

According to Mabuchi:

> In this plasma processing apparatus, in which the microwave is propagated in the dielectric sheet, it is possible even for a large flat section of the dielectric sheet disposed in parallel to a microwave window to propagate the microwave uniformly. Consequently, it is possible even for a large microwave window to transmit the microwave uniformly into the reaction chamber. (Col. 3, lines 35-42)

> The plasma processing apparatus based on this invention is characterized in its window supporting beam structure as follows. Slit openings are formed by beams of the window supporting member. The

> slit openings have their shorter side dimensioned greater than or equal to 1/6 of the wavelength of the microwave and smaller than or equal to the microwave wavelength, and are arranged at a spacing smaller than or equal to the microwave wavelength. The slit openings having the above-mentioned dimension enable the microwave to pass through and generate plasma.
>
> The arrangement of these slit openings at the above-mentioned spacing results in the dispersion of the beams which creates a shadow against the microwave and also the enhancement of the electric field in each slit opening. The arrangement of the slit openings at a spacing smaller than or equal to the microwave wavelength also enables the utilization of the diffraction of microwave. Consequently, the pattern of unevenness of the electric field distribution in the reaction chamber can be made finer, and plasma becomes to be uniform by diffusion in a short distance from the window supporting member. (Col. 3, line 63 – col. 4, line 16)

Thus, according to Mabuchi, uniform microwave propagation is accomplished by the above-structure. Namely, according to Mabuchi, by arranging the beams such that the openings between the beams are spaced apart a distance smaller than or equal to the microwave wavelength and by forming the slits such that their shorter side is greater than or equal to 1/6 of the wavelength of the microwave and smaller than or equal to the microwave wavelength, uniform transmission of plasma is accomplished.

As acknowledged by the Office "Mabuchi et al fail to explicitly disclose the length of the slit opening in terms of the wavelength of the microwave." In fact, Mabuchi does not even suggest that the length of the openings is important or that it can or should be manipulated so as to provide improved results. Rather, according to Mabuchi, uniform propagation is accomplished without taking the length of the openings into account.

Applicants, on the other hand, have unexpectedly found that by making the opening of the slot antenna to have a longer side with its length equal to half the space wavelength of the dielectric, superior radiation characteristics are achieved.

Applicants respectfully submit that Yoshiki does not remedy these deficiencies in Mabuchi.

Yoshiki describes generally a plasma processing apparatus that includes, among other elements, a rectangular waveguide 18 having long slots 18b, 18c, a microwave transmitting window 1, a window 7c and a plasma chamber 7 (See Fig. 1; see also, e.g., Fig. 5, wherein the waveguide is depicted as 28 ad the long slots as 28b, 28b'; Fig. 13 wherein the waveguide is depicted as 58 and the long slot as 58b). As clearly shown in the figures, the elements are arranged in the following order beginning with the plasma chamber: plasma chamber 7, window 7c, window 11, long slots 18b, 19c, waveguide 18. Thus, unlike the present invention, the "slot antenna plate" (waveguide 18) that includes the opening(s) ("long slots 18b, 18c) is not placed on a side facing said process chamber of the "dielectric" (microwave transmitting window 11). Rather, the waveguide 18 with its long slots 18b, 18c is placed on a side facing opposite the process chamber.

In particular, according to the present invention, the microwave that is generated passes through the dielectric 4, (then, in the event that there are two dielectrics, through the second dielectric 5), through openings in the slot antenna plate 7, and into the process chamber 2.

According to Yoshiki, on the other hand, a microwave that is generated is introduced into the rectangular waveguide 18, then the microwave is pradiated or projected into the plasma chamber from the long slots 18b and 18c through the microwave waveguides 16a and 16a', the microwave transmitting window, and the window 7c. (See, e.g., col. 2, lines 26-34)

In other words, the microwave propagation path of the present invention is through the dielectric(s) 4, (5) and then through the openings in the slot antenna plate 7, and into the process chamber 2. The microwave propagation path of Yoshiki, on the other hand, is through the long slots 18b, 18c through the microwave waveguides 16a and 16a', and then through the microwave transmitting window (dielectric), and the window 7c

Thus, the waveguide 18 is not a slot antenna plate in accordance with Applicants' invention and, further, the long slots 18b, 18c are not openings in a slot antenna plate in accordance with Applicants invention. In particular, Applicants teach a slot antenna plate that is positioned in between the dielectric 5 (or the dielectric 4 if there is only a single dielectric) and the process chamber 7. The openings are in the slot antenna plate and, accordingly, are also positioned between the dielectric 5 (or the dielectric 4 if there is only a single dielectric) and the process chamber 7. The long slots 18b, 18c of Yoshiki, on the other hand, are slots within the waveguide 18. The waveguide is positioned such that the microwave window 11 is between the waveguide 18 and the process chamber – in other words, the waveguide 18 is not between the microwave window 11 ("dielectric") and the process chamber 7. Thus, the waveguide is not a slot antenna plate in accordance with Applicants' invention. Further, the long slots are not openings in accordance with Applicants' invention.

Thus, Applicants respectfully submit that the Office is reading limitations regarding an element of Yoshiki into a completely different element of Applicants' invention. Namely, the Office has asserted that the properties of an element described by Yoshiki (waveguide/long slots) can be used for a completely different element (slot antenna plate/openings). However, as set out above, the waveguide and long slots do not qualify as a slot antenna plate/openings and, thus, the properties of Yoshiki's waveguide/long slots bear no relevance to a sompletely different element (slot antenna plate/openings).

Further, while Yoshiki describes that the longitudinal length of each long slot is set to ½ or more of the "free-space wavelength" of the microwave, the "free-space wavelength" of Yoshiki is different from the "space wavelength of the dielectric" as it is defined by the of the present invention.

Still further, according to Yoshiki, the "slots" comprise long slots having a length of approximately a few times longer than the wavelength of the microwave and serve as merely an entrance of the microwave to be propagated. According to Yoshiki,

a plurality of long slots are shifted from each other by (an-1) $\lambda/4$ so as to achieve uniformity of plasma processing. The present invention, on the other hand, takes advantage of superior radiation characteristics of the slot antenna that are exhibited when the openings of the slot antenna each have a length of approximately $\lambda/2$ and, thus, the concept of the slots of the present invention differs from that of Yoshiki.

Further, the Office asserts, in particular, that while the primary reference, Mabuchi et al, "fail to explicitly disclose the length of the slit opening in terms of the wavelength of the microwave" that "Yoshiki et al teach a microwave plasma processing system wherein the length of the slits are defined in term of wavelength of the microwave passing therethrough to be n/2 of a free-space wavelength of the microwaves in order to uniformly transmit microwaves into a process space * * * and, thus, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the slit dimension according to that taught by Yoshiki et al in order to generate plasma more efficiently and uniformly."

However, Mabuchi describes a plasma processing apparatus wherein a microwave window 4 ("dielectric") is supported by a window supporting member 5 ("slot antenna plate") having openings 6. The window supporting member 5 is positioned between the microwave window 4 and the process chamber. Thus, like Applicants' slot antenna plate and openings, the window supporting member 5 and openings 6 do not correspond to the waveguide 18 and long slots 18b, 18c of Yoshiki. Thus, the properties of Yoshiki's waveguide and long slots cannot properly be inferred into non-corresponding elements of Mabuchi (window supporting member/openings).

Still further, as set out above, according to Mabuchi, the structure of the window supporting member and openings as disclosed by Mabuchi accomplish uniform transmission of the microwave and, thus, there is no motivation to modify the structure disclosed by Mabuchi to achieve what has already been achieved - uniform microwave transmission.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). MPEP 2142.

As clearly set out above, Mabuchi does not teach or suggest all of Applicant' claim elements. In particular, as acknowledges by the Office, Mabuchi does not describe or suggest a slot antenna plate having opening(s) wherein the opening(a) have a length defined in terms of the wavelength of the microwave. Rather, this comes purely from Applicants' disclosure. Further, Yoshiki does not remedy the deficiencies of Mabuchi. The Office has asserted that Mabuchi can be modified so as to optimize the slit dimension according to that taught by Yoshiki et al. However, as clearly set out above, the dimension referred to by the Office is a dimension of an element that does not correspond to the element in question.

Accordingly, it is respectfully submitted that claim 1 is patentable over Mabuchi in view of Yoshiki. Claims 2-5 depend from claim 1 and, likewise, are patentable over Mabuchi in view of Yoshiki.

Katayama et al in view of Yoshiki et al

Claims 1-5 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Katayama et al (US Patent No. 5,545,258) in view of Yoshiki et al (US Patent No. 5,843,236). The Office acknowledges that "Katayama et al fail to disclose the length of the slit in terms of the wavelength of the microwave in the dielectric window." However, the Office asserts that:

> Yoshiki et al teach a microwave plasma processing system wherein the length of the slots are defined in terms of wavelength of the microwave passing therethrough to be n/2 of a free-space wavelength of

> the microwave in order to uniformly transmit microwaves into a process space (column 10, lines 12-26, column 19, lines 63-67, column 32, lines 8-11).
>
> Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the slit dimensions according to that taught by Yoshiki et al in order to generate plasma more efficiently and uniformly.

Applicants respectfully traverse for the reasons as set forth above. N In particular, the elements pointed to by the Office (waveguide and long slots) do not correspond to Applicants' a lot antenna plate or openings. Thus, any properties with relation to these elements are irrelevant.

Thus, claim 1 is patentable over Katayama et al in view of Yoshiki et al. Claims 2-5 depend from claim 1 and, likewise, are patentable over Katayama et al in view of Yoshiki et al. Reconsideration and withdrawal of the rejection is respectfully requested.

CONCLUSION

In light of the above amendments, Applicant respectfully requests early consideration and allowance of the subject application.

Applicants believe that additional fees are not required in connection with the consideration of the within matter. However, if for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, you are hereby authorized and requested to charge Deposit Account No. **04-1105.**

Should the Examiner wish to discuss any of the amendments and/or remarks made herein, the undersigned attorney would appreciate the opportunity to do so.

Respectfully submitted,

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